Key Factors for the Sustainable Production of Swiftlet Birds' Nest Industry in Malaysia: A Case Study in Northern Peninsular Malaysia

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***Abstract*—Swiftlet bird's nest plays significant role towards economic growth of the country and development of the industry becomes paramount. The objective of the study is to identify the key factors that contribute to the sustainable swiftlet nest production. A total of 223 swiftlet entrepreneurs were simple randomly selected from the study area. Descriptive statistics was used to identify the socio-economic characteristics of respondents and structural equation modelling was used to identify the factors that contribute to sustainable swiftlet production. Results revealed that most of the respondents were above 40 years old while almost half of the respondents have higher secondary school education. Livelihood assets, role of middlemen and role of institution were statistically significant in influencing sustainable production of swiftlet nest. These finding recommends for active monitoring and advisory services by relevant institutions and information dissemination about trainings to enhance producers' technical knowledge on swiftlet rearing. Indirectly this will improve the physical facilities, financial management skill and social networking of swiftlet producer in order to sustain their production. Likewise, middlemen should be enlightened more about their role in the marketing of swiftlet bird's nest and monitored by relevant authorities.**

Keywords*—Sustainable Production, Swiftlet Nest, Swiftlet producer, Livelihood Asset, Middleman, Institution*

1. Introduction

Swiftlet edible birds' nest under agriculture sector has been identified by National Key Economic Area (NKEA) as a high value product that have good agribusiness prospects, however needs more attention and improvement on its productivity [31, 8]. In order to ensure production of edible birds' nest for longer period, sustainability of swiftlet nest industry in Malaysia becomes paramount. Sustainable production of swiftlet nest industry can be achieved through favourable policy and proper monitoring by relevant agencies such as the Department of Veterinary Services, Ministry of Agriculture and local councils [8].

Swiftlet bird's nest is an important agricultural products for Malaysia which has contributed significantly to the national income and health of people. Swiftlets are extremely cherished due to their ability to use gelatinous secretion from two sublingual glands for edible nest production [7, 8]. According to [19], nests are produced from the feathers and saliva of swiftlets which is used as whiting agent on the skin and also good for the eyes. Moreover, it plays a great role to build up lungs and repair respiratory system for asthmatic people and significant constituent for Chinese medicine. It is also a good traditional substitute to modern medicine due to its rich glycoprotein saliva which stimulate good health through swiftlet soup and drink for people [5, 20]. Benefit derived from edible bird's nest to peoples' health has led to high price and demand by the society.

The industry is a lucrative business where the entrepreneur can earn thousands of ringgit from edible bird's nest per kilogram as profit [2]. Due to vital role of swiftlet bird's nest towards economic development of Malaysia, the government has given main concern to the growth of swiftlet bird's nest industry in the Economic Transformation Programme, Tenth Malaysia Plan [17].

Malaysia is the second exporter in the world after Indonesia, which contribute about 20% to the total market of edible bird's nests production [21]. Swiftlet nest production in Malaysia started around mid-1990s with a small house style set-up at a

natural cave area. As swiftlet industry expand, suppliers constructed artificial man-made environments which look like the natural cave for the swiftlets in order to sustain the supply chains [18, 13]. In 2010, Department of Malaysia Statistics reported that over 41 swiftlet bird's nest industry association have been established which has led to US$1 million (RM3 million) gross income and has provided employment and entrepreneurship aside from Chinese entrepreneurs who has dominated the swiftlet nest industry. This opportunity has given huge advantage to Malay indigenes to become swiftlet entrepreneurs in order to discover and grip prospect of the profitable swiftlet bird's nest industry [32]. According to Malaysia Ministry of Agriculture, swiftlet house owners and farm operators has been estimated to be 20,000 in the country in 2020.

Despite efforts carried out by several agencies, swiftlet industry still encountered quite a lot of setbacks which led to unstable global and local market price for raw and processed edible bird's nest. Furthermore, there exist barrier in the swiftlet industry in Malaysia due to problem encountered in exportation of edible bird's nest as a result of presence of nitrate to the export market in China [4]. Based on this, Malaysian government intend to promote the growth and marketing of swiftlet industry locally by producing edible bird's nest products such as cosmetics, foods, drinks and supplements for Malaysian consumers [19]. This will help to reduce reliance on export market to avoid previous problem encountered. Bird's nest industry have contributed significantly to the national income and measures to ensure sustainability of this industry should be given proper focus. Effective product supply chain plays an important role in ensuring the sustainability of agricultural projects concerned. If the bird's nest industry does not have a system of efficient supply chain, the industry will not last long. Therefore, the general objective of the study is to identify the key factors that contribute to the sustainable production of swiftlet nest in the Northern states of Peninsular Malaysia.

2. Literature Review

In Malaysia, swiftlet bird's nest is gaining extensive recognition due to high income realised from the swiftlet industry. Swiftlet edible nest produce nests for commercial purpose and human consumption [5, 2]. In swiftlet husbandry, production cost for construction of swiftlet house is high due to building, maintenance and security system costs. High cost of swiftlet house building does not indicate that high profits will be realised by the investor. The average monthly running cost for the swiftlet house is RM 75 which is low [19, 1]. Furthermore, Crystal Swiftlet Consultant Sdn Bhd assert that for the first three years of the swiftlet husbandry business, the income level realised from the swiftlet house will not be too significant [11, 21]. This is as a result of low bird population in the swiftlet house. Theoretically, it will take three to five years for saturation of the nesting area before increase of swiftlets population.

The major factor of sustainable production of swiftlet nest is the swiftlet house. According to [20], based on their observation on unsuccessful swiftlet project under eKasih programme found that the main factors contribute to the failure of the project because of poor management by the owners; swiftlet house did not meet the recommended conditions and then those houses become uninhibited by swiftlets. For a swiftlet house to be functional; temperature, intensity of light and relative humidity needs to be considered. Swiftlet entrepreneurs needs to invest on swiftlet house to meet up with the set standard such as installation of devices to control the temperature and relative humidity; provision of basic infrastructures such as electricity and water to ensure sustainability of the industry [1]. Furthermore, Department of Veterinary Services must ensure that adequate information needed for the successful construction of swiftlet houses are provided to ensure sustainability of the industry [8, 21]. In Malaysia, it has been discovered that most of the swiftlet houses are not registered and work without suitable license. Swiftlet entrepreneurs have chosen not to register their industry in order to avoid government tax [21]. Also, Ministry of Health needs to issue health certificate to guarantee health safety of the community where swiftlet houses are located [1].

In the world, China has been the major consumer of edible bird's nest since the beginning of swiftlet trade. It accounts for 70% of total consumption globally while swiftlet trade is majorly carried out in part of Hong Kong since years back. In 18th century, swiftlet trade stretched out quickly in China when demand of edible nests increased due to the significant role in people's health. Edible

bird's nests demand shoot up in China in the 20th century which resulted to opening of global market through importation of swiftlet nests [6, 7]. Most of the bird's nests imported to Hong Kong were consumed locally and few portion were shipped to other Asian countries. In Malaysia, below half of the edible bird's nests produced are consumed locally while larger percentage are exported to other countries such as Hong Kong Singapore and China [23, 7].

Some of the small-scale swiftlet entrepreneurs in Malaysia sell their harvested nests to the middlemen who later export to several countries or the entrepreneurs processed and cleaned the nests first before selling to the middlemen. Price of processed or raw bird's nest is different from one another. Globally, processed bird's nests price can be around RM15,000 ($3,550) in the market which is times three of the raw bird's nests. Unprocessed nests are sent to Indonesia for processing by the middlemen while swiftlet industry operating on large scale will process their nests since processing facilities is on ground [3].

Reviewed literatures indicated that scholars focused more on harvesting practices and swiftlets conservation; medicinal aspects of edible bird's nests; economy and business characteristics of the swiftlet husbandry industry [5, 14, 5, 1, 6]. Less research have concentrated on the sustainable supply of swiftlet nest industry in the Northern Corridor of Peninsular Malaysia. Therefore, need for better understanding of sustainability of edible bird's nest production becomes vital. Hence, this study highlight the factors that influence swiftlet nest production in the Northern Corridor of Peninsular Malaysia.

3. Methodology

The objective of this research is to identify the key factors that influence the sustainable swiftlet nest production. The study was carried out in Northern states of peninsular Malaysia; Perak, Penang, Kedah and Perlis. Survey was conducted on 223 swiftlet entrepreneurs which were simple randomly selected for this study. Structured questionnaires were used for data collection from the respondents which were administered with the help of enumerators to expedite the survey process. The design of the questionnaires was based on sustainable production model for swiftlet nest industry. The questionnaire was divided into seven parts; socio-demographic, livelihood assets, role of institution, role of middlemen, sustainable production of swiftlet nest, good swiftlet husbandry practice and problems faced by the entrepreneurs in the swiftlet industry.

Data collected were analysed using descriptive analysis to identify the socio-economic status of the respondents using Statistical Package for Social Sciences (SPSS) version 23. Structural Equation Modelling (SEM) was used to identify the factors that influence the sustainable swiftlet production using Smart Pls 3.0. The method used has been argued to be more suitable when dealing with complex model but using small sample size [10].

Table 1 presents the list of indicators for each category of dimensions used for the model. All responses to items are measured on five-point Likert scale ranging from strongly disagree (1) to strongly agree (5). Confirmatory factor analysis was carried out to assess validity which led to deletion of some items. Precisely, items which consist of lower loadings were deleted as proposed by [10] to achieve the Average Variance Extracted (AVE) baseline 0.5 and increase the composite reliability. Composite reliability (CR) was used in the study to evaluate the internal consistency of the constructs in order to ensure that values were above 0.70 which implies that values were satisfactory.

Table 1. List of variables used in the model

Dimensions	Items	Labels
Livelihood Asset (LA)	**Human Asset (HA)**	
	Attendance to the courses organized by the relevant agencies will help to succeed in this field.	HA4
	Experienced and knowledgeable employees is an important asset for the success of this industry.	HA5
	Duration of participation in the swiftlet nest industry influence the success of swiftlet industry.	HA6
	Full-time focus in this activity is one of the factors contributing to the success of this industry.	HA7

	Employers should be sensitive to the latest technological developments regarding the swiftlet nest to determine the success of this industry.	HA8
	Financial Asset (FA)	
	Swiftlet nest industry requires high capital and requires employers to make loans.	FA1
	Financial institutions are very helpful in providing loans with the minimum requirements	FA2
	Borrowings from financial institutions help to the success of the swiftlet nest industry.	FA3
	Dealings with financial institutions is very easy.	FA4
	The industry was able to run without borrowing from the financial institutions.	FA5
	Repayment of the loan can be paid within the prescribed period.	FA6
	Social Asset (SA)	
	For the success of swiftlet industry, entrepreneurs need to have a good relationship with any agency associated with the industry.	SA3
	Family support is one factor that determines the success of swiftlet nest industry.	SA4
	Good relationship with friends who run the swiftlet nest industry help to promote the industry.	SA5
	Good relations with surrounding communities to assist in advancing swiftlet nest industry.	SA6
	Safety factors such as fenced area, guards and others can guarantee the success of swiftlet nest industry.	SA7
	Physical Asset (PA)	
	Interior fittings in my swiftlet house is enough to maximize production.	PA11
	The size and height of swiftlet house can maximize production.	PA12
	The audio system used effectively to attract birds to build nests.	PA13
	Grilles system used can result in more swiftlet nest.	PA14
	Grilles system used can result in more high quality of swiftlet nest.	PA15
	Ventilation system used in my swiftlet house is effective to attract birds to build nests.	PA16
	Security systems (predators) have effectively maintain the population of swiftlet.	PA17
	Temperature control system used is sufficient to maintain the bird population.	PA18
	Natural Asset (NA)	
	Predators is one of the major factor that often interfere with presence of swiftlet to build swiftlet house.	NA3
	Swiftlet house location near the sea is more successful than the swiftlet house built in inland or lowland areas.	NA4
	Suitable weather housing is crucial in determining the quality of swiftlet nest.	NA5
	In overall, natural environment of my swiftlet house is appropriate for the maximum production of my swiftlet nest	NA6
Role of Institution (ROI)	**Ministry of Agriculture (MOA)**	
	Workshop/training/seminars organized by MOA is helpful.	ROIMOA1
	MOA website provides very useful information about swiftlet industry.	ROIMOA2
	MOA brochure is helpful to understand the role and services offered by the MOA and related institutions.	ROIMOA3
	The meeting with MOA is helpful to run the swiftlet industry.	ROIMOA4
	Trade negotiations conducted by the MOA with the Republic of China can improve swiftlet trading.	ROIMOA5
	The policy related to swiftlet industry is effective in promoting swiftlet industry.	ROIMOA6
	You can easily get the market price from MOA.	ROIMOA7
	Advice gotten from MOA is helpful to the swiftlet nest industry.	ROIMOA8
	Department of Veterinary Services (VSD)	
	Workshop/training/seminar conducted by the VSD effectively increase swiftlet nest production.	ROIVSD2
	The website/brochure VSD is helpful to get the information for swiftlet nest industry.	ROIVSD3
	Advisory services provided by the VSD helps to run SBW companies	ROIVSD4
	Visit from VSD help to run swiftlet nest industry.	ROIVSD5

	Compliance with the standards set by the VSD is important in advancing the company SBW.	ROIVSD6
	VSD assist you in understanding how to increase the production of SBW.	ROIVSD7
	Veterinary Health Certificate (VHC) improve the quality swiftlet nest production.	ROIVSD8
	Livestock Farm Practices Certificate (LFPC) improve the quality of swiftlet nest production.	ROIVSD9
	Certificate of Good Animal Husbandry Practice improve the quality of swiftlet nest.	ROIVSD10
	Council Region/Local Authorities (LA)	
	Application for license/permit obtained from local authorities within the prescribed time.	ROILA1
	Legal advice/regulations related to the swiftlet house site provided by local authorities is very useful in ensuring the viability of the swiftlet nest industry.	ROILA2
	Tax imposed on swiftlet house premises is reasonable.	ROILA3
	Payment of licensing/permit on the swiftlet house premises is reasonable.	ROILA4
	Application for occupant certificate (OC) is approved in a short time.	ROILA5
	Cleanliness maintenance offered by the local authorities to the swiftlet house premises is satisfactory.	ROILA6
	Employers Association Swiftlet (EAS)	
	Being a member of at least one association of employers in swiftlet nest is essential to promote swiftlet nest industry.	ROIEAS1
	The association might increase the frequency of events (two (2) times a year or more).	ROIEAS2
	The activities help increase swiftlet nest production.	ROIEAS3
	Activities carried out by the association helps to market swiftlet nest production.	ROIEAS4
	Association is the first party referred to when dealing with issues related to the swiftlet nest industry.	ROIEAS5
	Association channel the problems faced by swiftlet nest industry to the relevant agencies.	ROIEAS6
	Association disseminate the latest information related to swiftlet nest industry.	ROIEAS7
Role of Middlemen (ROM)	The middlemen play an important role in the sale of swiftlet nest.	ROM2
	Sale to swiftlet nest based products companies ensure the continuity of sale.	ROM3
	Buyers never return my swiftlet nest due to not meeting up with the standard.	ROM4
	Good relations between producers and middlemen is important to ensure the sustainability of swiftlet nest production.	ROM5
	My dependence on middlemen/wholesalers/buyers is very high.	ROM6
	I have full confidence in the integrity of middlemen/wholesalers/buyers.	ROM7
	I am satisfied with the prices offered by middlemen	ROM8
Sustainable Production (SP)	This activity generate favourable profit.	SP1
	My swiftlet nest production is sustained to meet buyers demand.	SP2
	Swiftlet nest sold to buyers for regular and unscheduled.	SP3
	To ensure the continuity of the industry, entrepreneurs need to process their own swiftlet nests	SP4
	The industry has a good potential in the long term.	SP5
	Revenue of swiftlet nest can cover the repayment of loans made from financial institutions.	SP6

4. Results and Discussion

4.1 Socio-economic characteristics of respondents

Table 2 shows the descriptive statistics of demographic factors of respondents in the study area. Results revealed that swiftlet entrepreneurs is dominated majorly (78%) by males. Meanwhile, about 56.9% of the respondents were above 40 years old. According to [12], males are well represented in the swiftlet industry compared with females. In terms of ethnic group, Chinese had the highest number (78%) followed by the Malays (20.6%) respectively. This implies that Chinese are majorly the entrepreneurs in the swiftlet industry in the study area which is in agreement with [31]. From the study, 43.5% of the respondents have higher secondary school while 19.7% had Sijil/STPM/Diploma qualification respectively.

This shows that respondents are educated. Since this swiftlet nest production used complicated technologies and it is requires educated person to manage the production process. According to [31] educated with positive attitude person will be able to absorb latest technologies introduced. Study by [8] stated that educational level helps to strategize better when it comes to marketing of agricultural products.

Table 2. Descriptive statistics of socio-economic characteristics of respondents (n = 223)

Variables	No.	%
Gender		
Male	174	78.0
Female	49	22.0
Ethnic status		
Malay	46	20.6
Chinese	175	78.5
India	2	0.9
Age (years)		
≤ 21	2	0.9
21 – 40	94	42.2
41 – 60	114	51.1
> 60	13	5.8
Educational level		
No formal education	18	8.1
Primary education	14	6.3
Lower secondary education	30	13.5
Higher secondary school	97	43.5
Sijil/STPM/Diploma	44	19.7
Degree and above	20	8.9
Other job aside swiftlet nest		
Labourer	4	1.8
Breeders	17	7.6
Rice farmers	14	6.3
Private sector worker	16	7.2
Government servant	10	4.5
Retirees	21	9.4
Businessmen	86	38.5
Factory worker	20	9.0
No second job	35	15.7
Experience of swiftlet husbandry		
1 – 10	204	91.5
11 – 20	13	5.8
> 20	6	2.7

Source: Field data survey

In order to enhance their technical knowledge on swiftlet production only few of the respondents attended training on Swiftlet Rearing Courses (23.8%), Good Animal Husbandry Practice (GAHP) (25.6%), Good Swiftlet Rearing Training (35.4%) and Seminar MyGap (Malaysia Agriculture Practice) (18.4%) respectively. This may be due to distance of the training centre with the respondent's location, lack of awareness on training information [8] and most of the respondents venture into swiftlet nest production as part time job. However, 91.5% of the respondents have between 1-10 years' experience in swiftlet husbandry.

4.2 Characteristics of swiftlet production

Table 3 presents the characteristics of swiftlet nest production. Training attended by the respondents indicated that only 23.8% of the respondents were present for the swiftlet rearing course, 25.6% attended Good Animal Husbandry Practice (GAHP), 35.4% attended Good Swiftlet Rearing Training (GSRT) while 18.4% attended Seminar MyGap (Malaysia Agriculture Practice) respectively.

Table 3. Descriptive statistics of characteristics of swiftlet production

Variables	No.	%
Type of training attended		
Swiftlet rearing courses		
Yes	53	23.8
No	170	76.2
Good Animal Husbandry Practice		
Yes	57	25.6
No	166	74.4
Good Swiftlet Rearing Training		
Yes	79	35.4
No	144	64.6
Seminar MyGap		
Yes	41	18.4
No	182	81.6
Land ownership		
Owner	194	87.0
Lease	29	13.0
Number of swiftlet house owned		
1 – 5	219	98.2
6 – 10	4	1.8
Type of used wood grilles		
Meranti	6	2.7
Normal wood (ex: albasia)	215	96.4
Teak wood	2	0.9
Height of swiftlet house (storey)		
1 – 3	171	76.7
4 – 6	50	22.4
> 6	2	0.9
Average production of unprocessed swiftlet nest per kg/year	35.24	
Average price per kg of unprocessed swiftlet nest (RM)	2,083	
Annual sales/total revenue of unprocessed swiftlet nest (RM)	73,434	
Annual production cost (RM)	45,486	
Net Income (RM)	29,040	

Source: Field data survey

Meanwhile the organizers of the training include Department of Agriculture and Association of Swiftlet Entrepreneurs. Findings revealed that majority (87.0%) of the respondents were the owner of the land used for swiftlet nest production while 13.0% lease the land respectively. Results also showed that majority (85.7%) of the respondents owned between 1-2 swiftlet houses. Meanwhile, almost all (96.4%) of the respondents used normal wood such as albasia for the construction of their swiftlet house. Furthermore, based on height of swiftlet house, majority (76.7%) of the respondents have swiftlet houses ranging from 1–3 storeys while 0.9% have above 6 storeys respectively. Results indicated that average production of unprocessed swiftlet nest is 35.24kg per year with an average price of RM2,083.80/kg.

4.3 Factors influencing the sustainable production of swiftlet nest

4.3.1 Measurement model

As discussed in section 3, the sustainable swiftlet production was hypothesized to be influenced by livelihood assets that comprises of human, financial, physical, natural and social assets; role of institution and role of middleman. Table 4 presents the convergent validity of each latent variable. From the loadings results, all the items loading values were above 0.60 which is the baseline. Similarly, the Average Variance Extracted (AVE) values of the latent variables were greater than the acceptable threshold of 0.5 while result of composite reliability of the latent variables ranges from 0.811 to 0.940. This implies that validity and reliability of the measurement instrument are good.

Table 4. Measurement model evaluation

Variables	Items	Loading	AVE	CR
Human Asset (HA)	HA 4	0.727		
	HA 5	0.755	0.573	0.843
	HA 6	0.800		
	HA 8	0.744		
Financial Asset (FA)	FA 1	0.692		
	FA 2	0.832		
	FA 3	0.843	0.542	0.875
	FA 4	0.790		
	FA 5	0.610		
	FA 6	0.611		
Social Asset (SA)	SA 3	0.614		
	SA 4	0.732		
	SA 5	0.774		
	SA 6	0.815	0.557	0.862
	SA 7	0.782		
Physical Asset (PA)	PA 11	0.760		
	PA 12	0.742		
	PA 13	0.676		
	PA 14	0.807		
	PA 15	0.838	0.580	0.917
	PA 16	0.779		
	PA 17	0.752		
	PA 18	0.727		
Natural Asser (NA)	NA 3	0.653		
	NA 4	0.692	0.519	0.811
	NA 5	0.782		
	NA 6	0.748		
Role of Middlemen (ROM)	ROM 2	0.665		
	ROM 4	0.692		
	ROM 5	0.677	0.527	0.869
	ROM 6	0.740		
	ROM 7	0.765		
	ROM 8	0.806		
Role of Ministry of Agriculture (ROIMOA)	ROIMOA 1	0.654		
	ROIMOA 2	0.839		
	ROIMOA 3	0.858		
	ROIMOA 4	0.848	0.664	0.940
	ROIMOA 5	0.812		
	ROIMOA 6	0.819		
	ROIMOA 7	0.850		
	ROIMOA 8	0.822		
Role of Veterinary Services Department (ROIVSD)	ROIVSD 2	0.630		
	ROIVSD 3	0.770		
	ROIVSD 4	0.802		
	ROIVSD 5	0.729		
	ROIVSD 6	0.755	0.524	0.908
	ROIVSD 7	0.734		
	ROIVSD 8	0.756		
	ROIVSD 9	0.613		
	ROIVSD 10	0.702		
Role of Local Authority (ROILA)	ROILA 1	0.703		
	ROILA 2	0.765		
	ROILA 3	0.728	0.565	0.886
	ROILA 4	0.741		
	ROILA 5	0.806		
	ROILA 6	0.764		
Role of Swiftlet Farmers Association (ROIEAS)	ROIEAS 1	0.719		
	ROIEAS 2	0.707		
	ROIEAS 3	0.711		
	ROIEAS 4	0.841	0.570	0.902
	ROIEAS 5	0.762		
	ROIEAS 6	0.764		
	ROIEAS 7	0.771		
Sustainable Production (SP)	SP 1	0.763		
	SP 2	0.842		
	SP 3	0.753	0.601	0.900
	SP 4	0.770		
	SP 5	0.808		
	SP 6	0.710		

4.3.2 Path Coefficient

Figure 1 shows the final model of sustainable production of swiftlet nest for the case of Northern states of Peninsular Malaysia. Finding showed that all the loadings of the items/indicators were above the standard point of 0.60 (Figure 1) as recommended by [9]. The results revealed that validity and reliability of the instrument are good

while composite reliability (CR) used to assess internal consistency of the constructs were appropriate and above 0.70 which implies that it is satisfactory based on the threshold point. Likewise, results of Average Variance Extracted (AVE) values of the latent variables were higher than the acceptable value of 0.50 which is in line with [9].

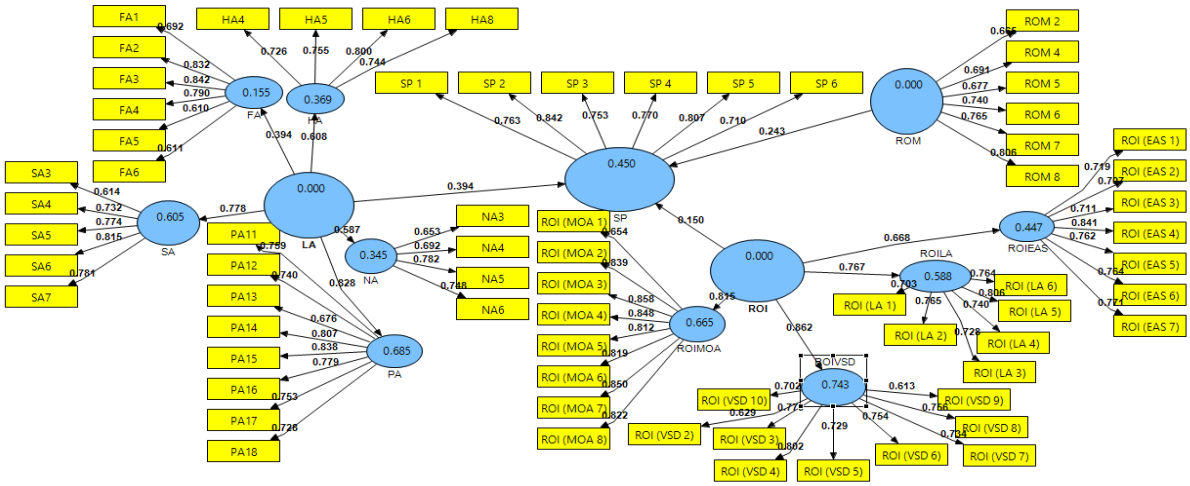

Figure 1. Structural model for sustainable swiftlet production

Table 5 presents path coefficient results of the latent variables. Results indicated that livelihood assets which include financial, physical, natural, social and human assets; and role of middlemen have positive significant relationship with sustainable production. Meanwhile, role of institution with sustainable production was not significant based on the t-value but path coefficient value is greater than 0.1. This is in line with [16], which stated that path coefficient value greater than 0.1 is significant. The hypothesized path relationship between livelihood asset and sustainable production; role of middlemen and sustainable production; and role of institution and sustainable production were statistically significant based on path coefficient values greater than 0.1. However, it can be concluded that livelihood asset and role of middlemen are strong predictors of sustainable swiftlet production while role of institution are weak predictors.

Table 5. Path Coefficient of Latent Variables

Path	Path coefficient (β)	Standard Deviation (std.)	t-value
LA-SP	0.394	0.156	2.529**
ROM-SP	0.243	0.147	1.651*
ROI-SP	0.150	0.139	1.076
R^2	0.450		

Moreover, the result of the analysis revealed that coefficient of determination (R^2) value of the model is 0.450 which implies that the model developed has substantial impact on sustainable production of swiftlet. This implies that the three (3) latent variables explain 45.0% of the sustainable production of swiftlet. According to [16], the value of R^2 of endogenous latent variable should be more than 0.26 for a good model.

4.3.3 Discussion

Result revealed that the livelihood asset is the most important factor influencing sustainable production of swiftlet production. Physical and human assets seem as the dominant contributors to the dimension of livelihood asset with their factor loading more than 0.8. These result implies that entrepreneur who has complete physical facilities of swiftlet nest house and possess technical knowledge with regards to swiftlet rearing will sustain in their production. Furthermore, [20] stated that physical assets in terms of basic infrastructures for the swiftlet house is essential for sustainable production. If the swiftlet house does not meet up with the recommended conditions, birds will not be attracted into the house and edible birds' nest produced in such house will be of low quality. In order to increase production level of birds' nest,

Department of Veterinary Services needs to provide necessary information to the swiftlet entrepreneurs on appropriate methods to increase productivity [21]. Also, Ministry of Health needs to certify the swiftlet house to ensure production of good quality birds' nest [1].

This study also revealed that role of middlemen also positively significant in influencing sustainable production of swiftlet nest. This implies that swiftlet producers heavily rely on middlemen to market their products. Undeniably the involvement of middlemen in agricultural marketing will certainly reduce the profits that producers should have, and even increase the price of a product in the market. However there are many functions to be carried out in moving the agricultural products from producers to customers. This result was consistent with the findings by [15] that stated the reason for the high percentage of agriculture producer's dependable on middlemen is as a result of the fact that middlemen are the bulk buyers and in some cases they assemble adequate volume of raw products and convert them into more marketable forms. These assembly costs included transportation of agricultural products from the farm to an assembly point where products are stored, graded, or converted into more marketable forms. There is no doubt therefore that additional marketing and distribution functions may need to be accomplished such as managing inventory, filling orders, transporting products to customers, or providing other related customer services. These services are very tasking for a farmer who primarily is at the production sector in the channel of distribution.

Then, the weak effect of the role of institution on sustainable swiftlet production revealed that most of the swiftlet producers have distant relationship with related government officers. This statement was supported by the result of less than 30 percent of swiftlet producers attended the training organised either by Ministry of Agriculture, Veterinary Services Department and Swiftlet Producers' Association. Hence, massive engagement in training and more frequent visits by the officer is necessary to build good relationships between institutions and producers to strengthen monitoring towards achieving optimal Good Agricultural Practice among swiftlet producer.

5.0 Conclusion

Swiftlet bird's nest is a highly valued agricultural products due to its rich glycoprotein saliva which inspire good health through swiftlet soup and drink for people. This has increased the production level and numbers of swiftlet entrepreneurs. However, sustainability of the swiftlet bird's nest industry has to do with solving problems encountered by the swiftlet entrepreneurs in the industry, role of government agencies and marketing strategy that commonly depends on the middleman. Effective role of middlemen and role of institution will help to improve sustainable production of swiftlet bird's nest, reduce cost of production, increase swiftlet entrepreneurs' profit and promote good health among the people. Path coefficient values showed that livelihood asset and role of middlemen are good predictors of sustainable production of swiftlet.

This study recommends that government agencies should assist the swiftlet entrepreneurs financially by securing loans for them with low requirements and less charges in order to invest more capital to realise more profit in the business. Also, institution such as Ministry of Agriculture, Department of Veterinary Services, Local Authorities and Swiftlet Producer's Association should provide useful information such as workshops, training or advisory services to the swiftlet producers' to enhance their technical knowledge on swiftlet rearing. Once they equipped with necessary knowledge, indirectly they will know how to improve their physical facilities, financial management skill and social networking in order to sustain their production. Likewise, middlemen should be enlightened more about their role in the marketing of swiftlet bird's nest. In addition, edible birds nest products must be properly processed and monitored by relevant authorities.

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